Department of Agriculture, Trade and Consumer Protection
Division of Agricultural Development
Agricultural Development & Diversification Program (ADD)
Grant Project Final Report

Contract Number: 21014

Grant Project Title: Feasibility Study to Evaluate the Economic Viability of a Perch-Based Grower and marketing Co-operative in Wisconsin

Amount of Funding Awarded: $14,000

Name of Principal Contact Person: William M. West

Organization: Blue Iris Fish Farm/Northeast Wisconsin Fish Co-operative

Email Address: blueirisenv@gmail.com

WEB Address:

Report Submitted on: March 26, 2008

---

1. The original intent of the grant was to determine if it was feasible for a group of perch growers to form a co-operative which would be the vehicle to market and sell perch. Past history suggested that there were a number of fish farms in Wisconsin producing perch but in the end, none had sufficient quantity of fish to sustain a market. The assumption was that if a co-operative could pool the harvest from a number of smaller operations, there would be a growing number of contributors who could depend on some entity which would be responsible for marketing and sales. Conversely, there would also be a market that could get used to the idea that the supply would be more consistent.

   What was learned however is that there really is no significant supply of fish being grown in Wisconsin. Therefore, in the big picture, we not only had to find out if it was feasible to form a co-operative to market fish, it also became necessary to identify if it was feasible to raise perch economically in Wisconsin. This study therefore focused on the numerous tasks necessary to accomplish each stage of the "egg to market" process of raising perch to identify shortcomings and bottlenecks preventing success. The significance of this study therefore is that it does identify how and why there is such a poor showing for perch production, and it may have nothing to do with economics. The importance of this study is not that it can be shown that a co-operative can be successful but rather that the blueprint and outline for achieving successful farm operations has been developed. If growers adopt the blueprints, then the co-operative will be successful.

2. As noted above, to understand the logistics of the perch market, there was a significant amount of background information developed. Not only did the study include an in-depth evaluation of each process but also evaluated whether or not a co-operative could assist growers in any given phase of production. Bulk purchasing of commodities was also evaluated. In many cases, potential income was provided to assist farmers in identifying production income relative to various growing components. The in-depth evaluation of the industry and production components is what led to the identification of the shortcomings of the industry.

3. The accomplishments of this study are significant. These accomplishments include:
   a. This study exposed a significant need to supply growers and potential growers with a training package. The necessary training to result in forming aquaculture "businesses" is not being done nor are there entities in the State of Wisconsin who understand the full scope of training necessary.
   b. Past research efforts in Wisconsin have pitted the outdoors growers against the indoor growers. Studies which have been conducted as an offshoot of this project suggests that an outdoor/indoor

tandem approach may be the only economically viable approach to getting perch to market in a year or less. This has been proven!

c. Production which has been conducted as an offshoot of this project has shown that previous production in indoor settings has gone from a dismal production of one batch in two to three years to up to two and three batches per year. This is a six to nine fold increase in production from an indoor system.

4. Based on the in-depth evaluation of the perch industry the following conclusions can be made:
   a. Two years ago at the start of the project the consensus of industry was that indoor aquaculture had a long way to go to be economical and that outdoor aquaculture was the viable program. After researching information and studying systems and system components, the opposite might be true. Huge advancements have been made in the indoor aquaculture arena in the past several years though most advancements have not been taught in Wisconsin. Conversely, outdoor production has been stagnant. There is now a move to optimize outdoor systems to enhance and increase outdoor aquaculture production but again, there is no one in Wisconsin moving in this direction with the exception of the members of this co-operative steering committee.
   b. Production of outdoor systems can be significantly increased with minimal energy input. Moreover, production increases are not a function of how many ponds one has but rather how to make better use of the water. This aspect has significant industry impact because of the high price of building ponds, the expansive acreage formerly devoted to ponds, and the potential environmental concerns over discharges from high capacity systems. Intensive outdoor systems can be started with very reduced capital input with significantly higher production outputs.
   c. Real training for growers and potential growers is abysmal and certainly not provided in Wisconsin. Without proper training, failure is guaranteed. The Wisconsin landscape is littered with hundreds of millions of failed investment to back up this statement.
   d. To become a real business enterprise, growers need to understand the economics fish farming. The bottom line is that the minimum number of fish produced to be economically viable may be in the range of 100,000 to 120,000 annually. This is a quantum leap from being a backyard enterprise and it will take capital investment.
   e. Programs for financing need to be outlined and provided to potential growers. While there is a genuine need for low interest, long term loans, there actually does appear to be programs available in the State. However, most farmers do not have the ability to tap into the knowledge of where to begin sifting through the financial issues. Here again a day of financial training is warranted.

5. As a result of this project at least two members of the steering committee are already increasing production. Four to ten fold increases in production will be accomplished with less than five thousand dollar increase in equipment in the first year. With no additional equipment input beyond the first year, output projected for the second year will result in a 20 fold increase in revenue. This increase in production is just a matter of making better use of current water resources.

6. All of the resource material needed to develop the production noted above is available in print. However, no one in Wisconsin is training current and potential growers adequately. Growers are woefully lacking the technical training related to successful aquaculture, including emphasis on water quality, carrying capacities of systems, and economics.

7. The best way to use the results of the study is to follow the outline provided. It should be noted that better than 90% of the people interested in fish farming are not going to subscribe to what is needed to develop a business. Therefore, as a first step, there needs to be a general educational session for everyone interested in perch farming. From that general meeting, those who are ready to make a commitment can be gleaned from the candidates. Those then are the nucleus of the group that will venture forward with specific training. The following chart extracted from the study provides a first year program.

Step 1	Initial meeting	Invite interested individuals
		Objectives and goals must be clearly stated
		Candidates who wish to proceed must be committed
		Candidates who proceed will become core group
Step 2	Provide basic business and economic plan	Provide one or more days of economic and business development plan
Step 3	Develop individual business plans	Attendees identify which aspects of growing fish they wish to participate in
		Attendees identify personal limitations, responsibilities
		Attendees set individual goals
Step 4	Training	Attendees will receive training where necessary
Step 5	Initiate plans	Individual growers initiate plans for first year
		Individuals monitor progress toward individual goals
Step 6	Mid-term assessment	Meet to assess progress, modify plans as necessary
Step 7	First year assessment	Meet to assess first year progress
		Plan for second year
		Modify plans as needed
		Begin developing business plan for marketable fish which will be generated in second year. Will fish be pooled? Will a co-operative be formed to conduct marketing and sales?

Feasibility Study to Evaluate the Economic Viability of a Perch-Based Grower and Marketing Cooperative in Wisconsin

Prepared for

Department of Agriculture, Trade, and Consumer Protection

AG Diversification and Development Grant

By

William M. West, President
Blue Iris Fish Farm
Northeast Wisconsin Fish Co-operative

Agriculture Development and Diversification Program WDATCP Contract No: 21014

ACKNOWLEDGMENTS

This feasibility study has been funded by a Grant from the Wisconsin Department of Agriculture (Grant #21014). It is with a deep sense of gratitude that the author recognizes the State of Wisconsin for its dedication to the support of the aquaculture industry in Wisconsin. Moreover, the author would like to acknowledge the assistance of both funded and non-funded participants and collaborators in their assistance and cooperation in assembling the information necessary to pull this document together.

Gratitude is expressed to the following:

Wisconsin Department of Agriculture for providing financial support for this project.

Mike Bandli and Will Hughes, Wisconsin Department of Agriculture for critical review and support.

Anne Reynolds, UW Center for Co-operatives, Madison, WI., for critical review of the document.

Ron Johnson, Jim Held, and Sarah Kaatz, UW-Extension Specialists for critical review of the document.

Jeff Malison, Co-Director of the Northern Aquaculture Demonstration Facility for critical review of the document.

Brad Tork, Dan Gruendemann, Jerry Peplinski, and Kurt Rutlin, members of the Northeast Wisconsin Fish Co-operative steering committee and collaborators.

Gene Miller, unfunded collaborator whose insight into aquaculture particularly recirculation systems was invaluable.

Bill Lynch, whose insight into parallel aquaculture programs in Ohio was invaluable.

A. Executive Summary

In Wisconsin, the Friday night fish fry has historically been borne on the back of the perch industry. Perch supplies in the Great Lakes have been greatly reduced and over the past 30 years, many studies have been conducted to move perch production onto the farm. Investments in Wisconsin alone have well exceeded the $100 million threshold in indoor and outdoor facilities yet very little product is getting to market. There have been several small operations which have been successful for short durations but most have failed. There has never been a co-operative to manage product grown in Wisconsin.

This feasibility study is based on the assumption that there is a need for a co-operative to assist in the development of the perch industry. Within this study, aspects of the "egg to market" operations are evaluated to determine if there is a need to have a co-operative involved. Details of existing market and production data are provided along with current costs for various phases of production.

The current pricing structure for perch is somewhat artificial as it has been established based on production and operations which have not been optimized in either an outdoor or indoor setting. The current volume of perch going to the fish food market in Wisconsin is inadequate to support a co-operative effort. To achieve success, i.e., to have adequate supplies, the co-operative must rely on two factors:

1. Those who wish to raise perch in Wisconsin successfully have to be trained in each phase of the production process, and,
2. The co-operative must set the quality control standards which the fillets must achieve in order to qualify as a certain brand.

All of the information obtained for this feasibility study, including projections on profits is based on past five to ten year trends of the Wisconsin industry. There is a growing wealth of knowledge that suggests that production costs can be significantly reduced if fish farmers get into the "business" of raising fish. Once this has been accomplished, new production tables will need to be generated. However, at that point, perch aquaculture becomes extremely feasible.

Section 1 - Introduction

A co-operative can be useful in the management of multiple aspects in any industry. Logically, in a food-based co-operative, the function of the co-operative might be to manage the marketing and sales of products produced by growers or grower members. If a co-operative does indeed manage the marketing and sales of product, then it becomes imperative that the co-operative has a sustainable product with which to sell.

The Wisconsin perch industry supported by private growers is not very large. One wonders if development of a marketing and sales co-operative for private growers is putting the cart before the horse. Therefore, this feasibility study not only delves into the aspects associated developing a marketing and sales co-operative but necessarily evaluates each aspect of raising perch to determine if there are logistical problems which would prevent production of a sustainable product. In doing so, this study also evaluates whether or not it is logical for a co-operative to get involved with other aspects of raising perch.

This feasibility study is divided into two major sections. These sections include:

1. Evaluating opportunities for a co-operative in assisting in the raising of perch from maintaining broodstock up through the processing of perch and,
2. Evaluating opportunities for a co-operative in managing marketing and sales

Section 2 Opportunities for the Co-operative - Hatching through Processing

2.1 Housing and Maintenance of Broodstock

The housing and maintenance of broodstock is for the purpose of ensuring that there will be sufficient adults available to satisfy the minimum requirements for fertile egg production in the spring (or other seasons if out-of-season spawning is practiced). The practice of maintaining broodstocks is considered to be a function of local growers and not necessarily that of the co-operative.

The requirements for broodstock maintenance are the following;

a. Carryover of sufficient stock to supply the minimum amount of eggs each spring
b. Carry out the necessary replacement/recruitment to ensure vigorous new stock
c. Attempt to obtain improved genetics for one of several purposes including
    i. Select genetically faster growing fish
    ii. Select fish which may provide a better fillet yield
    iii. Select fish which may be more resistant to disease
    iv. Select fish which may be easier to feed train

There has been some work done in at Ohio State (Pollock 2005) and in Wisconsin at the Great Lakes Water Institute, Milwaukee on perch genetics and there may be some progress in the future with respect to some of the genetic parameters listed above. Additionally, there are growers at the national level already achieving significant growth and higher yields with specific stock (Miller, personal communication). In the future, there may need to be involvement by the co-operative in the owning and/or providing of specific strains of fish to members of the co-op if it is determined that in doing so, the co-op can provide a quality fish at a more economical price.

In Wisconsin, very few facilities have much data regarding the value of their broodstock. Value is based on several factors and will be judged on the success of generations of perch in the future. While it is difficult to assign value to broodstock, a grower must begin gathering data on the success of offspring much like a dog breeder focuses on the desired characteristics for pedigreed dogs.

Adult broodstock in Wisconsin have gone for $10 per fish or more. These fish typically are at least 10 inches in size. Perch up to 15 inches or more are not uncommon but if purchasing larger fish, one must recognize that these fish may be short lived and may have less egg production and fecundity. Therefore, 10 – 12 in perch may provide several years of good production. A grower must also consider between 10 and 20 percent replacement of broodstock each year.

Whether a farmer grows out his own fish or sells all of his production, he must know how many broodstock to carry and in what sex rations (male/female) in order to obtain the desired amount of eggs and production numbers. Maintenance, care and replacement of broodstock are discussed by Wallet (1999) and Daniels.

From the standpoint of function, it may be that the role of the co-op would be to establish agreements for members to obtain specific strains of genetics (eggs or post-hatch). These then would be available to qualified growers. Who would be a qualified grower? It is assumed that nearly anyone could grow fish. However, history suggests that failure is more common than success. Therefore, a qualified grower will, at a minimum, have to meet certain qualifications. These might become membership criteria for the co-operative. These characteristics include:

a. Minimum water quality standards will need to be met to ensure high quality product.
b. The grower must ensure that there is adequate backup of systems and contingency plan in place in the event of catastrophic component failure.
c. Grower must ensure proper and adequate feed to ensure success
d. Grower must ensure adequate records are kept.
e. Grower must have a plan to ensure the health of the fish. This plan may include components of a HAACP program, veterinary health inspections and biosecurity plan.

f. Grower must meet minimum requirements established by the co-operative for fish health, fillet quality, fish contaminant testing, etc.
g. Grower must subscribe to training if such training is provided or otherwise required of the co-operative.

2.2 Spawning and Hatching

There are several scenarios for spawning which include natural spawning outdoors or indoor spawning which may be natural or induced. Growers have a multitude of options in obtaining eggs from fish and hatching the eggs. Spawning option scenarios are discussed by Malison (1999), Gabel and Wallet (1999).

Some growers will allow broodstock to spawn on natural substrates in the pond. Ribbons of eggs, so spawned, can be left in place, can be transferred to other ponds for hatching, or can be transferred to indoor or outdoor tanks for hatching. Alternatively, growers can obtain eggs from other growers (possibly the co-op) and use these as the basis for their annual production.

As another alternative, some growers have a captive broodstock which allows for the ability to induce spawning or otherwise obtain eggs in a tight time window. Once eggs are obtained, there is generally the same requirement for indoor hatching as noted above.

From the standpoint of the co-op, there appears to be an opportunity to assist in stock management by obtaining of eggs from qualified vendors. These vendors may be co-op members however, the mechanism for providing eggs, guaranties of egg viability, etc., has yet to be addressed. All the considerations addressed in Section 2.1 above under broodstock apply here. In the past five years there have been instances from within Wisconsin (personal experience) and Ohio (Lynch, personal communication) as well as other states that there have been regional factors (usually weather related) which have caused whole regions to have catastrophic egg failure. Because this is not uncommon, there is the suggestion here that perhaps the co-op needs to be eventually involved in identifying sources of eggs (or fry) outside of the region or state which can be used to augment local supplies. This aspect will need to be done on a larger scale than just within Wisconsin.

In recent years, reduced egg production and egg viability have become a major concern. These trends coupled with other natural weather phenomena during critical spawning time windows can significantly reduce a year's production locally or regionally. While it is possible for a small number of farmers to provide significant stocks of eggs to the market within Wisconsin, localized catastrophic events indicates that if fewer farmers are producing eggs, the more likely a catastrophic event at one or two facilities could send ripple effects throughout the region.

There is a genuine need for growers to successfully spawn and hatch fish in large quantities. While this process seems straight forward, in recent years growers in Wisconsin have been sporadically successful (more consistently unsuccessful). A consistent supply of quality fish at this stage or successive stages cannot be guaranteed. This has had a devastating impact on the market because of the unreliable availability of fish for grow-out or for indoor culture.

In the 1980s it was common knowledge that growers annually sacrificed up to 80 percent of the fish that hatched up through the feed training stage – and that seemed acceptable. Now, we see numbers reverse of that – success from hatch through feed training at 80 percent or more. However, even with the higher success in survival, we are now first beginning to qualify fish based on their characteristics of being a premium fish. A "premium fish" is one that accepts feed readily, has reasonably good growth, and can reach a market size in relatively short time. These fish are selected from the general hatch by continuous size grading and by determination of conditioning factors (c-factors). A discussion of c-factors is provided in Chapter 9 of the Walleye Culture Manual (Summerfelt1996). Based on this scenario, we look at success as the number of premium fish that can be spawned out of a given cohort of fish. The number of premium fish which can be anticipated from a given number of eggs (assuming control over conditions by the grower) is about 15% (Miller, personal communication). Therefore, from a hatch of one million eggs, one should expect 150,000 premium fish. This is not to say that the rest of the fish are not useful because they are.

What is being said here is that if you intend to raise fish indoors, about 15% of your original number of eggs will result in premium fish. Outside of that, growers must be very careful about using less than premium fish in an indoor recirculation system as costs for growing begin to increase without a parallel increase in return on investment. If a grower is to spawn, hatch, and grow-out fish, you have to identify markets for your products. The following markets may be available:

Eggs sold as ribbons	→Anticipate between $15 to $40 per strand (dependent on size and quality)
Fry hatched and sold	→Expect between 3 to 4 cents per inch
Fingerlings feed trained	→Expect between 6 to 10 cents per inch
Fingerlings feed trained and size graded	→Expect between 8 and 13 cents per inch (assumes mostly premium fish)

As described above, premium fish are destined for indoor aquaculture (food fish market). Other markets exist for non-premium fish – mostly stocking programs. Fish with low growth potential and fish which have demonstrated poor feed training potential can always be used as a forage base for other valuable species.

2.3 Fingerling Rearing to Feed Training Size

In Wisconsin, spawning of yellow perch will likely take place between the beginning of April to the middle of May. This could be accelerated or delayed depending on how far north or south in Wisconsin a grower is located. A number of factors will accelerate or delay the onset of spawning but in general, this time window can be used. Once the perch have spawned and hatched, the fry are transferred to tanks or ponds for initial feeding.

Regardless of whether fry are fed in tanks or ponds, there must be adequate preparation of the initial holding waters. That is, holding waters used to house fry must have an adequate supply of feed for the intended amount of stocked fry. Typically, the fry will need water which has been pre-fertilized to develop adequate algae (green water) which is used to feed a requisite amount of zooplankton to satisfy the fry. Moreover, continuous fertilization is required to provide an adequate supply of zooplankton for up to eight weeks or more. Discussions on pond fertilization are provided by Morris (1999) and Held (2007).

In indoor systems, feed training may start immediately or in combination with supplemental green water. In outdoor systems, feed training may start immediately. Generally it is more practical to begin feeding fry using a well fertilized pond containing a preponderance of zooplankton.

In order to supply the anticipated demand (housing early life stages will require multiple facilities) it is unlikely that the co-operative could provide any physical resources at this stage. That is, most farmers will provide individual facilities and raise their stock on an individual basis. There is little that the co-operative could provide with the exception of training.

Based on information gathered during this feasibility study, it appears that there is a great deal of uncertainty by growers as to the proper methods for fertilizing a pond. There are many types of fertilizers available and each farm situation will likely require the tweaking of formulas to meet the immediate needs of the individual facility. Therefore, while the co-operative may not get involved in the day to day rearing of fry from hatch to two months, there may be a need to provide co-operative sponsored training. The first such training session for pond fertilization was conducted in Wausau, Wisconsin (March 2007, presentations by Morris and Held).

This stage is absolutely critical if a grower is to get fish up to the feed training stage. From the preceding section, if was noted that severe losses of fry are usually encountered within this time window (up to 80% losses are not uncommon and whole production seasons have been lost within this window, though usually due to weather). Poor initial feeding during early growth stages may result in undernourished fish. Even if these fish survive they may never subscribe to being a “premium fish.”

2.4 Feed Training Fish

In Wisconsin, intensive feed training will not likely start prior to July. As noted earlier, some facilities may wish to introduce artificial feeds under a controlled environment earlier. However; intensive feed training usually begins in July.

Feed training techniques will vary depending on whether you feed train indoors or outdoors. Many growers feed train in ponds using artificial lighting to attract the fish to a feeding station. However, more success has been realized when the fry, now between 0.75 and 1.25 inches, are feed trained indoors, raceways or possibly pond side tanks under controlled conditions.

Feed training and the ability to provide guaranteed feed trained fingerlings have been the Achilles heel of the perch business for the last twenty years. While it is absolutely imperative that all indoor grow-out facilities receive guaranteed feed trained fingerlings for grow-out, it is also an absolute must for pond growout facilities as well. We have seen severe losses in fingerlings during the transition from the feed training stage to the final indoor growout stage. These losses are due to a number of factors including inadequate feed training, stresses due to transportation and handling, and improper recirculation (indoor tank) system preparation. To prevent these losses from occurring, each of these causes needs to be addressed.

Feed training will likely be conducted on individual farms where hatching or growout will also occur. It is unlikely that the co-operative can add anything to enhance the work of individual growers except that the co-operative may be the entity which provides training on feed training. One feed training session was conducted in July 2007 as a prelude to what needs to be conducted on an annual basis. Discussion on feed training are provided by Wallet (1999), Gabel and Held (1998, July 2007 – Feed Training Workshop, Lake Mills, WI).

Between hatching, fry culture, feed training, and grow-out, there may be opportunities for individual farmers to cooperate among themselves. For instance, one farmer may carry broodstock and hatch fish while another farmer may only specialize in feed training fish for a number of farmers. These individual cooperative efforts can be conducted without involvement by the co-operative unless it is perceived to be beneficial to have the co-operative involved.

Over the past ten years, the author has become familiar with many facilities and observed feed training protocols. These feed training windows have ranged from as little as two days to as long as three to four weeks. Based on these observations, it appears that three weeks may be a minimum amount of training needed to accomplish feed training. This may be shortened under certain conditions but any grower attempting to feed train should not shorten the time window until experience dictates. Feed training has historically been the time when most fingerlings are lost and this is an area where good growers have learned to decrease their losses. At this stage, a fish going into feed training may be worth 3 to 4 cents an inch and within a month be worth between 8 to 13 cents per inch, a substantial increase.

2.5 Grow-out of Perch

After feed training is accomplished, grow-out of fish will commence. Grow-out is the time period from the end of feed training until the fish is market size. In outdoor systems, the size range of fish will be from three to six inches by the end of the first year (September). In indoor systems, there will be no loss of growth over winter and fish should continue to grow-out uninterrupted.

Once fish are feed trained, there are a multitude of opportunities for grow-out. Some of the options include:

a. Transfer all fish to indoor systems and complete grow-out
b. Transfer all fish to ponds until winter, transfer to indoor systems to over winter and grow-out
c. Transfer all fish to ponds, over winter in ponds, resume growth in spring
d. Cold bank fish for later use (holding feed trained fish in a reduced temperature setting with minimum maintenance provided)
e. Transfer to pond pens or raceways where one would have access to fish all winter

Discussions on these various systems are provided by Potter (2002), Lorsordo (1998, 1999), Masser (1999), Dunning (1998) and Lazur (1997).

Ideally, the quickest way to get fish to market is to use the best of all options. There are opinions as to what makes the best system, however, it appears that no indoor system can be adequately efficient and effective without using outdoors systems and likewise, no outdoor system can accomplish optimum production without a marriage with an indoor system.

Perch are capable of reaching an eight inch size within ten months of hatching. Some aggressive females have reached the six inch size window in a pond setting by the end of the first summer (5 – 6 months!). Granted reaching six inches in a pond setting and eight inches using a pond/recirculation tandem in these short time windows is a small portion of the total number. However, more recent data shows that under controlled conditions, a tandem pond/recirculation combination system can produce the first eight inch fish within five months post feed training (Miller, personal communication). Therefore, if feed training is complete within three months (May 1 to August 1) and grow-out occurs in five months, we appear to be capable of a complete cycle (egg to market) in as little as eight months for up to 20% of the batch and an additional 30 to 60% within the first year. Using combinations of both indoor and outdoor systems a fairly large number of fish will be of market size by the end of the first year (indoor) or the second growing season (all outdoor).

For the growout phase of perch, there is little the co-operative can do to facilitate operations.

2.6 Processing of Perch

The size of perch that are market ready ranges from about seven and one half inches to nine inches. The lower end, seven and one half inches may result in fish with too little fillet yield. However, high quality feed trained fish may still make the grade at that size. On the upper end, nine inches is almost too big. There are a number of growers who do not feed train their fish and fillet yields are poor unless fish up to nine inches are marketed. At nine inches we start seeing the prevalence of secondary bones which are not easily filleted out. If the end user is intending to deep fry the larger fish, bones will tend to fry out. If larger perch are grilled, the secondary bones might still be present and this is a disincentive for using the larger fish. Alternatively, farm markets are a good way to sell fish in the round, and here, fish that are nine to eleven inches are perfectly acceptable if not preferred.

A number of factors make up the fillet yield. Yield from individual processors may vary by as much as five to eight percent (personal experience with three different processors). Machine processed perch may have a reduction in yield by as much as five to ten percent. Whether a fish is wild caught or grown on formulated feeds may mean the difference between a 38 percent yield and a 52 percent yield. Feed trained fish from indoor systems have been known to consistently produce fillet yields over 50 percent. Some of the best pond feed trained fish yield in the high 40 percent (46 to 49) possibly to 50 percent. Pond raised fish without a diet of formulated feed may have fillet yields from the high 30 to low 40 percent levels.

There are two financial scenarios for a grower when ready to process fish off site. In the first scenario, the processor will purchase fish in the round. In this method, the processor owns the fish after they are processed or may have already made a deal with a secondary purchaser (possibly the co-operative). In the second scenario, the processor provides only the filleting service. Typically, the processor is compensated by the number of pounds of processed fish returned to the grower or again, a secondary purchaser. In either scenario, the processor has little or no incentive to process under-sized fish or fish with poor yield. Since the processor loses money by filleting small fish, the processor will likely set the minimum standard for fillet yield.

The price for filleting fish has steadily risen in the last 10 years. Prior to 2000, many facilities were charging less than $2.00 per pound for processing. Custom processing is generally over $2.00 per pound and has ranged as high as $3.50 per pound. To be cost effective, manual filleting must achieve a processing rate of at least two fish per minute. Processing machines can achieve much higher rates however, speed sacrifices fillet yield and there is also the necessity of having a final inspection following machine processing.

Manual processing of perch can be effective and satisfy the needs of the industry for perhaps two to five years, and there may always be a demand for manual, custom filleting. It is likely that once perch production is moving forward; there will come a time when automated machine filleting will be required.

The co-operative may need to assist in the marketing and selling of fish obtained from the processor. The co-op can work in conjunction with the processor or independently. Once the amount of fish processed exceeds the ability of processors to manually manage the inventory, an automatic fillet machine may be warranted. At this time, there may be a need to have a co-operative participate in the purchase of the machine.

As part of the processing activity, the processor may elect to provide packaging and labeling services for the co-operative.

2.7 Summary of Co-operative Opportunities Prior to Marketing and Sales Activities

Table 2-1 below provides a summary of basic operations that are required to take a perch from an egg to market. Where applicable, operations in which the co-operative can participate are listed. In many cases, it is best to let the growers manage their business without input from the co-operative. However, in order to provide a consistently high quality product to market, someone has to establish quality control standards. Likewise if the co-operative purchases product from growers on a consistent basis, these growers need the tools to do so and this may require co-operative sponsored training.

Services that the co-operative could provide in addition to marketing and sales are:

a. Coordination of feed sales with bulk deliveries
b. Coordination of veterinary fish health testing
c. Owning and operating a central or satellite processing facilities

Table 2-1
Opportunities for Co-operative Assistance

Operation	Benefit by Co-op	Participation of Co-op
Broodstock	Yes	Co-op may be in a purchasing position if someone has superior genetics or preferred stocks
Eggs	Yes	Co-op may be in a purchasing position if someone has superior genetics or preferred stocks
Feed	Yes	Co-op should be able to negotiate for member prices
Hatching and incubation	Usually provided by grower	May provide training
Pond fertilization	Yes	May provide training and bulk fertilizer purchasing
Fingerling grow-out	No – provided by grower	
Feed training	Yes	May provide training and set quality standards for fingerlings
Grow-out	No – provide by growers	Possible coordination of member resources
Processing	Yes	Once volume increases, it may become necessary for the co-operative to invest in automated processing systems. Co-op could assume processing role.
Marketing and Sales	Yes	Objective is to have the co-operative purchase all farm-raised fish and conduct marketing and sales. Lack of a central repository has resulted in inconsistent product in the marketplace.
General training	Yes	Co-operative must ensure that individual members are adequately trained in methods of successful perch culture. Lack of training will proliferate failure.
Quality Control Standards	Yes	Co-operative must develop a set of quality control standards which will result in a consistently high quality product which can then be marketed as such. This is important if the co-operative is to develop a "brand," and the brand is to connote a specific meaning.
Veterinary Services	Yes	Co-operative should be able to coordinate and obtain member prices for services. There is no reason that individual growers could not work among themselves to accomplish the same.

Section 3 Factors to Consider for the Successful Co-operative (Purchasing through Marketing and Sales)

3.1 Understanding the Breakeven Costs of Raising Perch

Any individual grower may elect to assume the duties associated with processing, marketing and sales. This practice has been done for several years. However, history has shown that most go-it-alone enterprises usually at one time or another, run out of fish. Once this happens, the individual is scrambling to find substitutes and may not be satisfied with the emergency batch if it does not meet quality standards. This has led to unhappy customers on all sides of the fence. Therefore, the position of the co-operative has been to purchase every qualified farm-raised perch and pool the purchases into a single production volume. In so doing, the co-operative has the opportunity to pace the sale of its stock and can thereby satisfy its customers more readily. The only caveat is that the co-operative must set the quality control standards for product that it will purchase so that the product meets the minimum requirements of the buyers.

In order to understand the feasibility of having a co-operative manage any aspect of the egg to market perch industry, there are two competing aspects of the industry which must be in sync. First, it must be feasible to raise perch and second, it must be feasible to purchase market-sized fish from growers and profitably market the fish at a competitive price.

There are several studies which provide the breakeven or budget costs of raising perch in ponds (Malison unpublished NCRAC report, Held 2005, Riepe 1997a, 1997b)). Likewise, there are also studies conducted by Fred Binkowski at the Great Lakes Water Institute in Milwaukee, Wisconsin which provide an assessment of costs associated with raising perch in indoor recirculation systems (Malison, 2006 NCRAC annual report). Based on these studies, we can predict the costs of raising perch in both indoor and outdoor settings. Rare or absent is the study that has combined the benefits of the outdoor with indoor systems for optimized production. One presentation was given in 2006 at the Mid-West Yellow Perch Forum (July 14, 2006, West, unpublished) which discussed the benefits of combined production. This approach was demonstrated at the Northern Aquaculture Demonstration Facility, Bayfield, Wisconsin (September 2006 ongoing demonstration). Preliminary results indicate that perch can be raised in tandem outdoor/indoor in batch form and, an indoor setting can effectively harvest two crops per year. One grower in Ohio recently was capable of three crops in 2007 using select feed trained fish as starters (Lynch, personal communication)

Using current indoor and outdoor enterprise budget estimates, one can assume that pond prices for perch in the round may be in the range $2.40 to $2.60 per pound. Likewise, indoor production estimates result in prices between $6.00 and $7.00 per pound in the round. As new production data becomes available, these numbers may be viewed as conservative. There are a considerable amount of variables for each system and between individual growers. For instance, one simple variable is the fillet yield of the perch. Typical yield estimates for pond production systems range from a very low of 36 percent all the way up to 48 percent (possibly higher). On the other hand, indoor systems typically have much higher percent yield with a low yield being around 48 percent with yields over 50 or 52 percent expected.

3.2 Limitations of Current Pond Data and Studies

We can use the $2.60 per pound in the round number to drive the feasibility study estimates but it is likely a conservative number. This is true because no Wisconsin pond system has developed production estimates based on solving for the wastewater treatment needs of the pond. That is, there is no study that maximizes pond production by operating ponds like recirculation systems. In order to maximize pond production, one must ensure that all waste is treated so that feeding and feed uptake can be maximized. Once this has been accomplished, outdoor systems will be able to increase their production. The impact will therefore decrease the cost of production perhaps lowering the cost below $2.00 per pound in the round. This has significant impact on the industry because of the overall potential to bring lower cost product to market.

It is true that the benefit of a pond system is that it is less costly to operate. However, by letting the pond clean itself (denitrify and re-oxygenate), by guessing at the standing crop, and by guessing at the true uptake of the standing crop, we certainly do not optimize production by going low cost.

One of the problems we see in perch production is that it is always easier to move perch as soon as possible than to grow them out for human consumption. There has always been a better market for stocking perch (at any size) than to grow them to market size over two years. A producer can move fish in the fingerling stage and doing such does not tie up ponds more than one year. Similarly, a producer can raise fish up through the feed training stage. By August or September of their first year those fish could be moved. Therefore, it has been attractive to move fish which are not for consumption. Not only is there a quicker turn around, but the price is better, there is less labor, and the ponds are used for a shorter period of time. In addition, growers may need to move fish to generate cash flow – especially in the early years of operation.

Since so many fish have been moved to market as stockers, there has been little incentive to develop true cost savings protocols for producing and moving fish for consumption in an outdoor setting.

3.3 Limitations of Current Recirculation System Data and Studies

Much of the current recirculation system data from Wisconsin-based studies relies on incomplete data sets and may not include major capital costs. A compilation of three Wisconsin-based studies by Binkowski (2005 NCRAC annual report) suggested that there were wide variances in production and this could have been attributed to major variances in systems. This author is aware that at least one of the systems had dealt with poorly trained fingerlings and the system experienced major losses as a consequence. These losses tend to skew the final costs for production and in this case, could over estimate production costs. This in itself is quite significant because in all studies reviewed (including outdoor systems), fingerling costs make up at least one third of the cost of any system.

There are opportunities to decrease the cost of perch production in both indoor and outdoor systems and these opportunities will add more to the bottom line if realized.

3.4 Feasibility of Marketing and Selling Perch

If we use current cost estimates, an estimate of whether or not it is feasible for a co-operative to provide marketing and sales functions for growers can be obtained.

All the cost variables need to be addressed in order to determine feasibility. If we use a $2.60 per pound in the round as a grower number, then all other costs assumed by the grower can be ignored (cost for broodstock, feed, growing the fish to eight inches, etc.). The costs for the co-operative will be related to the following variables:

- Fillet yield of perch (assume options include ranges from 38 to 52 percent)
- Cost of purchasing fish
- Cost of processing (assume ranges from $2.00 to $3.50 per processed pound)
- Cost of packaging and labeling (1, 2, 5, 10, 15 pound packaging, IQF, vacuum seal etc.)
- Cost of storage
- Cost of marketing and selling fish

3.5 Costs Associated with Processing

There are many quality control parameters that will make up the end product. One of the easiest parameters which we do have control over is the percent yield of the fillet. Since most of the processors charge for fillet yield, there is little incentive for any processor to accept inferior fish i.e., fish that lack minimum fillet yield. However, no one has established a minimum fillet yield; though a processor knows the difference. There is a wide range between fish that are feed trained in indoor systems and those which are caught wild. Therefore, unless pond-raised fish are feed trained, there will be less incentive for a processor to fillet pond-raised fish. Table 3-1 provides a chart which incorporates the variables associated with processing.

In the first seven columns of Table 3-1, straight calculations are provided assuming that a fish weighs one pound. Since fish at market size commonly weight between three and four fish to the pound in the round, columns seven through thirteen calculate values of earnings based on ranges for fish between three and four to a pound.

Table 3-1
Costs Associated with Processing

lbs fish	%yield	return per 1000 lb	No. fish fillet per min	Min. per shift	No. fish per shift	lb fish per shift	Shift lb fish @ 3 fish/lb	Shift Earnings @ $2.25/lb	Shift lb fish @ 3.5 fish/lb	Shift Earnings @ $2.25/lb	Shift lb fish @ 4 fish/lb	Shift Earnings @ $2.25/lb	$ per 1000 pound
1000	38	380	2	360	720	274	91.33	$205.50	78.29	$176.14	68.50	$154.13	855
1000	39	390	2	360	720	281	93.67	$210.75	80.29	$180.64	70.25	$158.06	878
1000	40	400	2	360	720	288	96.00	$216.00	82.29	$185.14	72.00	$162.00	900
1000	41	410	2	360	720	295	98.33	$221.25	84.29	$189.64	73.75	$165.94	922
1000	42	420	2	360	720	302	100.67	$226.50	86.29	$194.14	75.50	$169.88	945
1000	43	430	2	360	720	310	103.33	$232.50	88.57	$199.29	77.50	$174.38	968
1000	44	440	2	360	720	317	105.67	$237.75	90.57	$203.79	79.25	$178.31	990
1000	45	450	2	360	720	324	108.00	$243.00	92.57	$208.29	81.00	$182.25	1012
1000	46	460	2	360	720	331	110.33	$248.25	94.57	$212.79	82.75	$186.19	1035
1000	47	470	2	360	720	338	112.67	$253.50	96.57	$217.29	84.50	$190.13	1058
1000	48	480	2	360	720	346	115.33	$259.50	98.86	$222.43	86.50	$194.63	1080
1000	49	490	2	360	720	353	117.67	$264.75	100.86	$226.93	88.25	$198.56	1102
1000	50	500	2	360	720	360	120.00	$270.00	102.86	$231.43	90.00	$202.50	1125
1000	51	510	2	360	720	367	122.33	$275.25	104.86	$235.93	91.75	$206.44	1148
1000	52	520	2	360	720	374	124.67	$280.50	106.86	$240.43	93.50	$210.38	1170

Based on the Table 3-1, there is about $80 difference per person per shift in income between the worst and best yielding fillets when perch weigh three to a pound. The difference is smaller when fish are three and a half or four to a pound. Other hidden variables in this chart are the number of fish that can be processed per minute and how long a person can remain at the designated fillet rate. In the above scenario it is assumed that the processor will be working an eight hour shift but that his effective work rate is only six of the eight hours and even that might be ambitious. Other factors to contemplate include the fact that if a processor is working six hours per day steady. Additionally there have to be personnel feeding the processor scaled fish and someone taking away filleted fish for final cleaning, grading, packaging, and storage. Therefore, the values in the final column look good but have to take into account all the other costs of processing.

The processing numbers are important because this will be one of the largest costs next to obtaining the fish from a grower. Based on how the processor manages the variables will determine whether or not it is economical to purchase filleting services from one processor or another, whether or not a co-operative itself will own the processing service, or whether a decision has to be made to go from a manual processing operation to an automatic processing facility with filleting machines. Since there is not a filleting machine available on the market to date that can equal the fillet yield similar to manual filleting, a similar cost analysis will have to be

conducted to determine the breakeven point for consideration of machine filleting versus manual filleting. Perhaps one easy way to predict the breakeven costs is to use a value between five and eight percent loss for automatic filleting. Based on past history, this value is considered to be reasonable. If a normal fish will fillet out manually at 50 percent, then from Table 3-1 one might realize an approximate 45 percent yield on the same fish done by machine.

Regardless of how the processing fees are determined, the co-operative is interested in the cost of the processed fish and the cost of the fish purchased in the round. At this point, the fish have not been purchased and we need to address the variables associated with purchasing farm-raised fish.

3.6 Factors Making up Decisions for Purchasing Fish

As noted in the section above, a number of factors make up the value of farm-raised fish. One of the biggest factors is the fillet yield. The co-operative also needs to address factors which make up the overall health and quality of the fish and resultant fillets. Pond-raised fish will have a greater propensity to suffer from parasitic infestation. The degree of infestation will determine the overall marketability of the fillets regardless of the fillet yield. Overall fish health has not come into play to any great extent in discussions thus far. In recent years there has been a great deal of attention being paid to fish contaminants such as mercury concentrations in fish. Therefore, there are numerous considerations to address relative to fish quality. The co-operative will need to make purchasing decisions based on fish health

Assuming that the co-operative purchases fish from either a farmer (in the round) or from a processor (processing fee plus in the round fee), the co-operative will pay both costs in the end. Therefore, it becomes important to know the answer to the following question. What is a reasonable price for perch in the round?

Tables 3-2 and 3-3 provide charts showing some of the variables which go into making up costs associated with purchasing fish. Again, these charts provide variables based on fillet yield and assume certain reasonable factors such as cost for filleting (which is also variable but is held constant in Tables 3-2 and 3-3 for the purposes of discussion).

Tables 3-2 and 3-3 have been developed to help visualize how profits might be assessed. In Table 3-2, values are provided as a percent return on investment. Table 3-2 was developed using a known cost for fish and processing and assuming an additional $1.00 for labeling, packaging, storage and transportation.

Table 3-3 presents the same data in a little different perspective. In Table 3-3, we take the same costs which were used to develop Table 3-2 including the additional $1.00 per pound added to include the costs for packaging, labeling and transportation. Table 3-3 shows the raw profit associated with 1000 pounds of fish at various fillet yields and at different purchase prices. As in Table 3-2, Table 3-3 still assumes a sale price of $10.00 per pound of fillets. One can easily calculate the profit if the fillets are sold for $11.00 or $12.00 per pound. For example, if you wish to know what the price for a 1000 pounds of fish with a fillet yield of 45% purchased at $2.50 per pound and sold at $11.00 per pound, you would take the value set in Table 3-3 for $10.00 per pound ($537.50) and add $450.00 (assuming you are adding $1.00 to each of 450 pounds) to come up with a total value of $987.50.

Several calculations go into the makeup of Tables 3-2 and 3-3. Some of the variables have been set as constants, including the cost for filleting. In these tables, the percent yield is compared to that dollar amount that you might be willing to pay for fish in the round (a variable set from $2.50 to $3.00 in the second column from the left of Table 3-2). Two variables that are established as constants in these tables are: price per pound for processing fish ($2.25) and the selling price for a pound of perch ($10.00 per pound). The price of $10.00 per pound of frozen perch is not magical but it has been established as the minimum that fish farmers like to obtain for farm-raised fish. If the co-operative takes on the marketing and sales of processed perch, Tables 3-2 and 3-3 provide information as to whether or not $10.00 is even a reasonable number.

Tables 3-2 and 3-3 can be reconstructed to change all the variables and determine more cost effective returns. In order for a co-operative to realize financial stability – these exercises must be done.

Table 3-2
Calculations for Estimating %Return on Processing and Marketing 1000 pounds of Perch*

Initial Pound fish	Cost/lb round	38% $10/lb	39 $10/lb	40 $10/lb	41 $10/lb	42 $10/lb	43 $10/lb	44 $10/lb	45 $10/lb	46 $10/lb	47 $10/lb	48 $10/lb	49 $10/lb	50 $10/lb	51 $10/lb	52 $10/lb
1000	$2.50	1.74	3.52	5.26	6.98	8.67	10.33	11.96	13.56	15.14	16.70	18.23	19.73	21.21	22.7	24.11
1000	2.55	0.40	2.16	3.90	5.60	7.28	8.93	10.55	12.15	13.72	15.27	16.79	18.29	19.76	21.2	22.64
1000	2.60	-0.91	0.84	2.56	4.26	5.93	7.57	9.18	10.77	12.33	13.87	15.38	16.88	18.34	19.8	21.21
1000	2.65	-2.19	-0.45	1.27	2.95	4.61	6.24	7.84	9.42	10.98	12.51	14.01	15.50	16.96	18.4	19.82
1000	2.70	-3.43	-1.70	0.00	1.67	3.32	4.94	6.54	8.11	9.65	11.18	12.68	14.15	15.61	17	18.45
1000	2.75	-4.64	-2.92	-1.23	0.43	2.07	3.68	5.26	6.82	8.36	9.88	11.37	12.84	14.29	15.7	17.12
1000	2.80	-5.82	-4.12	-2.44	-0.79	0.84	2.44	4.02	5.57	7.10	8.61	10.09	11.55	12.99	14.4	15.81
1000	2.85	-6.98	-5.28	-3.61	-1.97	-0.36	1.24	2.80	4.35	5.87	7.37	8.84	10.30	11.73	13.1	14.54
1000	2.90	-8.10	-6.42	-4.76	-3.13	-1.52	0.06	1.62	3.15	4.66	6.15	7.62	9.07	10.50	11.9	13.29
1000	2.95	-9.20	-7.53	-5.88	-4.26	-2.67	-1.09	0.46	1.98	3.49	4.97	6.43	7.87	9.29	10.7	12.07
1000	$3.00	-10.27	-8.61	-6.98	-5.37	-3.78	-2.22	-0.68	0.84	2.34	3.81	5.26	6.70	8.11	9.5	10.87

*Estimates have not included any calculations so far for costs beyond purchasing the fish and processing. Additional costs will include packaging and labeling, storage, transportation, and market and sales.

Table 3-3
Calculations for Estimating Return on Processing (with Labeling and Packaging) 1000 pounds of Perch

Initial # fish	Cost/lb round	38% $10/lb	39 $10/lb	40 $10/lb	41 $10/lb	42 $10/lb	43 $10/lb	44 $10/lb	45 $10/lb	46 $10/lb	47 $10/lb	48 $10/lb	49 $10/lb	50 $10/lb	51 $10/lb	52 $10/lb
1000	$2.50	$65.00	$132.50	$200.00	$267.50	$335.00	$402.50	$470.00	$537.50	$605.00	$672.50	$740.00	$807.50	$875.00	$942.50	$1,010.00
1000	2.55	$15.00	$82.50	$150.00	$217.50	$285.00	$352.50	$420.00	$487.50	$555.00	$622.50	$690.00	$757.50	$825.00	$892.50	$960.00
1000	2.60	-$35.00	$32.50	$100.00	$167.50	$235.00	$302.50	$370.00	$437.50	$505.00	$572.50	$640.00	$707.50	$775.00	$842.50	$910.00
1000	2.65	-$85.00	-$17.50	$50.00	$117.50	$185.00	$252.50	$320.00	$387.50	$455.00	$522.50	$590.00	$657.50	$725.00	$792.50	$860.00
1000	2.70	-$135.00	-$67.50	$0.00	$67.50	$135.00	$202.50	$270.00	$337.50	$405.00	$472.50	$540.00	$607.50	$675.00	$742.50	$810.00
1000	2.75	-$185.00	-$117.50	-$50.00	$17.50	$85.00	$152.50	$220.00	$287.50	$355.00	$422.50	$490.00	$557.50	$625.00	$692.50	$760.00
1000	2.80	-$235.00	-$167.50	-$100.00	-$32.50	$35.00	$102.50	$170.00	$237.50	$305.00	$372.50	$440.00	$507.50	$575.00	$642.50	$710.00
1000	2.85	-$285.00	-$217.50	-$150.00	-$82.50	-$15.00	$52.50	$120.00	$187.50	$255.00	$322.50	$390.00	$457.50	$525.00	$592.50	$660.00
1000	2.90	-$335.00	-$267.50	-$200.00	-$132.50	-$65.00	$2.50	$70.00	$137.50	$205.00	$272.50	$340.00	$407.50	$475.00	$542.50	$610.00
1000	2.85	-$285.00	-$217.50	-$150.00	-$82.50	-$15.00	$52.50	$120.00	$187.50	$255.00	$322.50	$390.00	$457.50	$525.00	$592.50	$660.00
1000	2.90	-$335.00	-$267.50	-$200.00	-$132.50	-$65.00	$2.50	$70.00	$137.50	$205.00	$272.50	$340.00	$407.50	$475.00	$542.50	$610.00
1000	2.95	-$385.00	-$317.50	-$250.00	-$182.50	-$115.00	-$47.50	$20.00	$87.50	$155.00	$222.50	$290.00	$357.50	$425.00	$492.50	$560.00
1000	$3.00	-$435.00	-$367.50	-$300.00	-$232.50	-$165.00	-$97.50	-$30.00	$37.50	$105.00	$172.50	$240.00	$307.50	$375.00	$442.50	$510.00

3.7 Co-operative Costs Beyond Processing

In order to determine total cost, the co-operative must identify costs which are necessary to market a product. After the fish are processed, the activities which must be performed to move the product from processing to market include the following:

- Packaging and labeling
- Addressing short and long-term storage needs.
- Setting up a point of contact for marketing and sales strategies
- Transportation of product to points of sale

The mechanics of packaging and labeling are fairly straight forward. Many small businesses already have installed such processes. Most short and long-term storage includes some type of packaging which prevents freezer burn of the product while providing a safe environment for the product. Some packaging options that have been investigated include vacuum sealing, instant quick freeze (IQF), and others in combination with freezing. Packaging will likely involve developing products for individual sales (one or two pound packages) and restaurant sales (packages of multiple pound lots of 10, 15, and 20 pounds). Restaurants generally prefer their product as IQF, some pre-breaded but most frequently not. Based on preliminary assessments, costs associated with packaging and labeling, transportation, and product storage will add between $0.50 and $1.00 per pound of fillets.

Once the operation becomes sufficiently large to handle volume, there will be a need to assess automatic packaging/labeling/IQF machines. Preliminary estimates indicate that costs for used IQF equipment may run as high as $50,000 but the added cost of fish so packaged is less than $0.10 per pound.

3.8 Setting up Point of Contact for Marketing and Sales

The basic premise for this feasibility study is that a co-operative should be the entity responsible for marketing and selling farm-raised perch. From the discussion above, it would appear as though there is a genuine need for a co-operative to organize certain aspects of marketing and sales as well as other activities. However, it has also been pointed out that the going price for farm-raised perch is somewhat higher than wild caught perch as well as other seafood and substitutes. Therefore, offering marketing and sales as a function of the co-operative is tenuous at best. One only need look at Tables 3-2 and 3-3 above to see what profits could be achieved under various scenarios. It would appear that in order to subsidize marketing and sales efforts, the price for perch would have to be $11.00 per pound at a minimum. Granted there are specialty markets, farm markets, and high end sales where perch have gone as high as $16 to $19 per pound but these situations are far and few between and do not result in substantial sales volume. In order for a co-operative to be in a position to market and sell fish, the volume has to be substantial and there has to be a reasonable markup. If one considers the warehousing, long and short term freezing needs, transportation issues, and part-time assistance in accomplishing sales, it will likely take tens of thousands of pounds annually to support a co-operative investment.

This is going to take several years to accomplish. Why? Because if there were a significant amount of growers willing to begin in 2007 with outdoor facilities, it would take two years to get the first batch to market. Since we need an equal amount of indoor facilities to ensure year around production, construction of indoor facilities will likely take two years plus one year of production to get a batch to market. In reality, it will take up to five years to start realizing a substantial influx in the market. These assumptions and predictions are all based on what we have seen relative to traditional aquaculture in Wisconsin.

Even though it may take several years to obtain a supply of fish which would be deemed “sustainable” in the marketplace, for the purposes of this study, several end users were interviewed to better understand the needs of the market and what the co-operative should expect to produce for each potential customer. There are several types of customers and each customer may have specific product requirements. These requirements may range from very little to very demanding. Table 3-4 below lists several of the customers along with some of the requirements identified for this study.

The information in Table 3-4 is not exhaustive, however it points to requirements and opportunities for the marketing and sale of fish to various customers. The co-operative will have an opportunity to provide value-added products but not all customers will want to pay for the extra value. There is a need to provide packaging that is most desired by customers. Not all customers require testing for contaminants such as mercury or require a guarantee that our fish are not exposed to chemicals, or use quality feeds, etc. When customers request this information, the product can be marketed as a value added commodity.

Table 3-4
Product Criteria Per Market Segment

Market Type	Desired Product Quality					
	Fish size	Filleted	Packaged	Breaded	Tested for contaminants	Guarantee free of chemicals, additives, etc
Farm Market	9 to 12 inches, in the round or filleted	Yes or no	If filleted	No	Not requested	Not requested
Small restaurant	Uniform size 8 inches	Yes	IQF or frozen	Mostly no	Not requested	Not requested
Top restaurants	Uniform size 8 inches	Yes	IQF preferred	Mostly no	Some	Some
Specialty markets	Uniform size 8 inches	Yes	IQF preferred	Mostly no	Important to make quality statement	Important to make quality statement

One issue that surfaced when interviewing potential customers is the overall expectation of product quality. It was assumed by the author going into the study that the co-operative would be able to purchase fish from growers who did not necessarily feed train their fish but rather contained fish in large impoundments for longer periods of time. Fish so raised would be marketable a little later in life (longer to grow without formulated feeds) but never-the-less, would be the same fish. However, when evaluating these fish one quickly realizes that these fish (non-feed trained fish) are not the same fish in quality or size and therefore may not fit nicely into the size categories noted in Table 3-4. Based on the information obtained for this study, farm-raised fish which do not receive feed training will be different in quality for a number of reasons including:

- Fish will be thinner (less meaty) at the 8 inch size window
- Fish will need to be longer (9 inches minimum) to obtain the same fillet weight as an 8 inch feed trained fish
- Fish will be in the water up to two years longer to obtain the same length
- Fish will be exposed to contaminants longer because they are in the water longer and because they are consuming bioaccumulative contaminants that are not present in formulated feeds
- It will be more difficult to obtain uniform sized fish and it will be more labor intensive sorting fillets to obtain fillet uniformity when packaging.
- Fish longer than 8 inches start to begin getting secondary bones which may only be acceptable in farm markets and fish sold in the round.

For the above reasons, non-feed trained fish will be less acceptable to the co-operative and may be more expensive to process and market.

There has been some consideration for marketing undersized fish. These fish may be moved to market as a smaller size due to a number of reasons. These include:

- More economical to pull fish out of the water at a smaller size
- There are a number of fish in an outdoor pond at the end of the season that are just shy of eight inches and it would be costly to carry them over another year (these fish would presumably be seven to seven and a half inches, would be sexually mature, would lay eggs the following spring, and would need at least a month after spawning to regain their fall weight and another month to grow to market size)
- There may actually be a demand for what might be called a “petite perch fillet”

While the author recognizes this potential market, at this time, there is no one identified who would even try to fillet such fish and in fact, current processors avoid these size classes. Moreover, if there is a major move toward smaller fish to the point where there are enough fish of this size to be handled by a fillet machine, the petite fillet will be even that much smaller. Until such a demand (and associated pricing) warrants, the co-operative should focus on marketing a product no smaller than eight inches unless quality considerations dictate that slightly smaller products are acceptable.

The above discussion is mainly true for perch raised outdoors. We are starting to see indoor facilities with fish having significantly higher fillet yields at a smaller size (< 8 inches). The higher fillet yield includes both a higher percent yield and a higher weight. If this trend continues, smaller, more meaty fillets could well become the standard table fare.

3.9 Competitive Factors

There are three emerging competitive factors which will dictate pricing for farm-raised fish. Historically, farm-raised perch have always had to compete with wild caught for markets. Traditionally, wild caught from the Great Lakes have driven the price of fish in the round as well as supplies to restaurant and grocery stores. Additionally, local markets such as local seafood stores will carry supplies of wild caught perch seasonally. The second competing factor is the practice of product substitution. Currently, European zander is found throughout the traditional perch sales market and is mislabeled as perch. Third, while the consumer is waiting for someone to provide reasonably priced perch, other seafood products (both domestic and foreign) are slowly replacing perch at the Friday night fish fry and the supermarket.

The cost for wild caught fish has been normally dictated by markets out of Toronto (Lake Erie perch). In the past ten years, the price for wild caught perch in the round hovered around $1.60 and $1.70 per pound and that is the price that processors of Great Lakes fish were willing to pay for farm-raised fish. Individual farm sales during the same period ranged between $2.50 and $3.00 per pound in the round. During this same time window, wild caught fish were being sold on the market for a value of between $6.00 and $7.50 per pound. Recent prices for wild caught processed perch are $9.50 per pound, a value that is getting very close to the low end of farm-raised fish.

While the cost of wild caught perch is getting very close to farm-raised prices, farm-raised prices can be much better locally or regionally than $10 per pound. Some markets in Wisconsin will command prices for high end, premium, and/or value added perch up to $19 per pound. Ranges for perch between $12 and $14 per pound of fillets are common.

A couple of factors brightened the prospects for farm-raised fish in recent years. First, throughout the 1990s there was a significant crash of Lake Michigan perch. Recently this trend has somewhat reversed (at least for the bay of Green Bay), however, commercial harvests may never reach harvests of the 50s and 60s. Moreover, there still remains a significant harvest of perch from Lake Erie and that supply has made up for losses in Lake Michigan. As recent as 2005 however, the appearance of viral hemorrhagic septicemia (VHS) in Lake Erie as well as other Great Lakes may result in a more significant impact in perch supplies and the next several years may be important in determining the big picture with respect to Great Lake fish supplies relative to VHS impacts. Unfortunately, VHS may also come to plague fish farms and the impact of losses due to VHS and regulations relative to the movement of fish from farm to farm have yet to be determined. These aspects will likely play an important role in fish production for years to come.

When taking all of the competitive forces into account, it is clear that perch are going to be increasing in value and cost (both wild caught and farm-raised) and this trend could cause the consumer to lose their taste for perch. The problem for perch farmers is that the current cost for farm-raised perch is high relative to wild caught perch and even more so as compared to seafood substitutes. To compete with wild caught perch, farm-raised will need to show that there is value added to the product to warrant a higher price. To compete with substitutes, farm-raised perch will need to be competitively priced as well as be a value-added commodity. Research conducted for this feasibility study suggests that perch farmers can actually provide added value as well as be competitively priced.

3.10 What Will Make the Co-operative Feasible

Throughout this document, there has been ample discussion relative to each aspect of raising, processing, and marketing perch. Some of the training programs and research studies suggested within this document have been initiated and/or partially carried out. Results suggest that we are on the right track to making the whole program feasible.

It appears that there are three criteria to make a co-operative feasible.

1. There must be sufficient product available to the co-operative to make it feasible to carry out continuous marketing and sales for a profit,
2. The product must be of high enough quality or possess value added qualities so that it becomes less price sensitive, and,
3. The costs for producing the product become sufficiently low such that the products are market competitive regardless of value added quality considerations.

3.10.1 Addressing Supply Shortfalls

For the last two years, members of the co-operative have processed and sold less than two thousand pounds of perch annually. This is a very small number but it is likely that there were no more than double that amount of quality fish available to the co-operative within this same window. During that same period, members worked to maximize their operations. This was done by calculation the maximum carrying capacity of each farm throughout the various growout stages of raising perch, including over wintering. It was quickly learned that none of the existing growers have sufficient capacity to maintain a very large operation. For instance, in year one, we can grow almost 10 times the fish (up to four inches) as we can in year two growing fish from five to eight inches. We therefore learn that we are very limited in efficiencies of operation and in fact, outdoor ponds are extremely limiting as grow-out facilities.

To put it in another perspective, let's say a farmer was able to raise 100,000 fish annually. The market value is roughly equivalent to $100,000 assuming $1.00 per fish. The 100,000 fish may equate to roughly 10,000 pounds of fillets which seems like a lot of fish. However, the current consumption of perch in the Great Lake States is about 10 million pounds per year (more than half in Wisconsin), down from slightly less than 40 million pounds some two decades ago (Malison 1999). The 10,000 pounds identified above is five times what the co-operative was able to sell the last two years but 1000 times less than current consumption. There is no doubt that there is a huge demand for perch. However, there is not a single farmer in Wisconsin capable of making even a small dent in the supply chain. Supply will be the major problem confronting the co-operative.

What would it take to have sufficient supply to have continuous product for a co-operative? It is reasonable to assume that a single grower can distribute 2,000 pounds annually without too much effort. Once a grower gets about 2000 pounds of fish, it becomes more time consuming to market fish and that is where a co-operative can be very beneficial. It is likely that a co-operative would need to have between 50,000 and 100,000 pounds of fish annually to be able to guarantee a continuous supply to a steady customer base.

From Table 3-3 one can calculate profit from sale of 1000 pounds of fish and one can also establish a profit target. If the objective is to make $0.50 per pound, then the co-operative can make money on all fish with a fillet yield of 45% or greater (value on Table 3-3 must be $500 or greater). At $0.50 per pound, 100,000 pounds will generate $50,000 minimum. As can be seen on Table 3-3, the income for the co-operative becomes greater when fillet yields are higher. However, one must balance this greater income with the knowledge that the co-operative will likely have to pay more for a pound of fish in the round when fillet yields are higher – these are premium fish. Table 3-3 takes this into account and shows the profit margin based on variable costs per pound of fish in the round.

3.10.2 Addressing Quality Issues

Establishing quality control parameters is actually quite easy for the co-operative especially if it is demanded by the customer base. Therefore minimum standards for product and quality will result in a guaranteed product and that will be value added.

Unfortunately, establishing quality control may result in the loss of product coming to market because initially fewer fish would meet quality standards, and this could compound the supply issues.

3.10.3 Producing Lower Cost Products

Not much has been said in this document about producing lower cost products. The reason for this is that we have been building on established values for farm raised perch in both an outdoor and indoor system setting.

In recent years there has been much new data, mostly from outside of Wisconsin which demonstrates that both outdoor pond systems and indoor recirculation systems can produce perch much more economically than once thought. Miller (2007 personal communication) has been obtaining fish growth well beyond what was observed just ten years ago. Members of the co-operative have been experimenting with rigid feed training techniques, paying attention to conditioning factors, and combining indoor and outdoor systems to maximize growth in shorter time windows. Some of these efforts and concepts were demonstrated at NADF but still need optimizing.

To prove that these new concepts are workable, one only needs to look at growth charts of perch over the past ten years. Calculated growth windows have continuously been reduced over time from a poor growth window in the thirty plus month range to the low twenty month range (or lower). Moreover, by coupling maximum outdoor production with indoor production, a significant cohort of fish can be marketed between ten and eighteen months.

There are a number of factors which when used alone or in combination can lower the costs of production. These include:

- Increasing spawning hatch ratios
- Rigid control over feed training
- Size grading fish frequently into distinct growth cohorts
- Selection of genetically superior fish, selection of superior cohorts
- Maintaining control over light and temperature
- Determining fish quality based on conditioning factors
- Moving fish from outdoors to indoors at strategic times to prevent interruption of growth
- Ensuring proper water quality needs
- Establishing outdoor systems equivalent in practice as indoor systems
- Use of cold banking
- Recognizing that not all fish will be marketable as feed fish, learning to discern the difference, and preparing alternative markets for non-productive fish.

These efforts will definitely produce lower cost fish – fish that can actually compete with wild caught prices while still being of high quality.

Can a co-operative be feasible? Yes, but not in the immediate future. The co-operative will be successful once there is sufficient supply of fish to move through the system. Building a supply of fish for the market will not be accomplished unless growers re-learn how to maximize efficiencies in both pond and recirculation systems. The co-operative or a focus group needs to take responsibility for providing the training essential for this transition. Unless this is accomplished, there will be no production (or put more accurately, no economical production) and there will be no need for the co-operative.

It is estimated that the process of training and initial production could take up to five years to accomplish. There will be small gains over the first couple of years but major gains will not take place until several collaborative operations are established and production from these facilities reaches market (up to two years beyond training and obtaining first stocks to supply facilities).

3.11 Where To Begin

At this point, we are at the point of addressing the age old question; which came first, the chicken or the egg? In this case, we need to decide which needs to come first, the supply of fish or the co-operative? What are the limitations which have prevented the industry from taking off? Can a co-operative be formed to address the limitations and in so doing, jump start the industry?

In Ohio (Lynch, personal communication) there is a small group of growers who have been working together cooperatively without the formation of a formal co-operative. This group too has seen supply issues. In the past three years, Wisconsin has had a group of like-minded perch growers who have been working on the idea of forming a co-operative. At one time or another, this group has numbered as many as a dozen or so interested growers, however, that number has dwindled to less than five. The main reason that the interest wanes is that people are in love with the idea of growing perch (or any other species for that matter) but they are not prepared for the "business" of raising fish. This is very similar to the dairy industry in the sixties. Thirty years ago, it was not uncommon to see large families (8 to 12 children) running a dairy operation with the main bread winner off to the city working the real job. Now days with few children at home we have mega farms. Most of our fish farms are exactly like the dairy operations of yesteryear – a couple of ponds, a handful of feed, and a real job in the city.

So how can that be turned around? There are several conditions that need to be satisfied.

1. Fish farmers who wish to be in the business, need to know that it is a business not a hobby. It is too easy to be distracted by the aura or novelty of fish farming but unless the business is production-based, it will not survive. Too many times, we see tanks, ponds, raceways etc. without any fish in them. While this is okay for the beginning or end of production cycles or seasonal changes, a tank without fish is poor management. This business requires management and planning.
2. It has been many years since anyone in Wisconsin has presented or given a course on the economics of raising fish. This might be the most important aspect. Potential fish farmers need to know that they can make money if they are in the business of fish farming. A seminar to provide this information will not be a one hour event. It will take between one and three days to provide the basics to potential fish farmers. Such a training event should cover the aspects of the egg to market scenarios provided in Sections 1 and 2 above including indoor and outdoor operations.
3. Potential growers need to know that they do not have to do everything on their specific site. There are many opportunities for growers to share resources. It has already been pointed out that successful growers may specialize in one or more aspects of production but this also means that there may be a need for growers to cooperate with each other.
4. We need to turn around the financial side of the industry. Many of the small outdoor pond systems have been self funded. Conversely, many of the indoor systems (especially the larger operations) have been funded or backed by financial institutions. The lack of success in this area, especially indoor systems, has resulted in the wasting of capital which is now needed. The industry desperately needs successful indoor systems. In order to turn the financial issues around, the industry needs to accomplish two things. One, build one or more correctly designed indoor systems and two, man the indoor system with a competently trained manager. Fortunately, Wisconsin already has at least two functional facilities – one private and one public. The private system has already demonstrated the ability to raise fish exactly to specifications. The public system might be amenable to such a demonstration if the focus was specifically on achieving the goals of the fish farmer. Regardless, we do have the tools to begin.

So where do we begin. The chart provided below diagrams a possible sequence to follow for the first year. It is assumed that growers who make up the core group will be working toward a common goal – being successful in raising fish. The first seven steps will be undertaken the first year, however, it may be that it will take many meetings to accomplish training and developing business plans. At the end of the first year there may be no marketable fish (food fish size) though there may be fish available for other uses. It might be important to move fish in non-food markets the first year if it is necessary to generate cash flow.

Step 1	Initial meeting	Invite interested individuals
		Objectives and goals must be clearly stated
		Candidates who wish to proceed must be committed
		Candidates who proceed will become core group
Step 2	Provide basic business and	Provide one or more days of economic and business development plan

	economic plan	
Step 3	Develop individual business plans	Attendees identify which aspects of growing fish they wish to participate in
		Attendees identify personal limitations, responsibilities
		Attendees set individual goals
Step 4	Training	Attendees will receive training where necessary
Step 5	Initiate plans	Individual growers initiate plans for first year
		Individuals monitor progress toward individual goals
Step 6	Mid-term assessment	Meet to assess progress, modify plans as necessary
Step 7	First year assessment	Meet to assess first year progress
		Plan for second year
		Modify plans as needed
		Begin developing business plan for marketable fish which will be generated in second year. Will fish be pooled? Will a co-operative be formed to conduct marketing and sales?

While interested growers begin the first year, the demonstration facilities should be running normal operations so that training can be accomplished based on live operations. The critical point here is that the trainer will be the most important aspect. If the trainer is not well versed in the dynamics of the information that needs to be imparted, we will repeat the mistakes of the past thirty years. It may be the role of the co-operative or core group to ensure that the trainer is competent.

References

Daniels, Dr. Harry. Presentation: Broodstock management. NC State University, A&T State University Cooperative Extension.

Dunning, R, T.M. Losordo and A.O. Hobbs. 1998. The Economics of Recirculation Tank Systems: A Spreadsheet for Individual Analysis. SRAC Publication # 456. 7 p.

Gabel, S. Presentation: Fingerling Production. NC State University, A&T State University Cooperative Extension.

Held, J.A, J.A. Malison and T.E. Kuczynski. 1998. Techniques for the Commercial Production of Feed-trained Yellow Perch (*Perca flavescens)* Fingerlings. World Aquaculture Society Book of Abstracts, 29th Annual Meeting, Las Vegas, NV. P. 239.

Held, J.A. 2005. Pond Grow-out of Yellow Perch: Real Farm Numbers. Wisconsin Aquaculture Annual Conference, Wisconsin Rapids, WI. March 11-12, 2005.

Held, Jim. 2007. 2007. Pond Fertilization Methods for Yellow Perch Fingerling Production. Pond Fertilization Workshop – Managing the Bloom. Wausau, WI. March 9, 2007.

Lazur, Andrew M. and D.C.Britt. 1997. Pond Recirculating Production Systems. SRAC Publication No. 456. 6 p.

Losordo, T.M., M.P. Masser and J. Rakocy. 1998. Recirculation Aquaculture Tank Production Systems, An Overview of Critical Considerations. SRAC Publication # 451. 6 p.

Losordo, T.M., M.P.Masser and J.E.Rakocy. 1999. Recirculation Aquaculture Tank Production Systems, A Review of Component Options. SRAC Publication #453. 12 p.

Masser, M.P., J.Rakocy and T.M. Losordo. 1999. Recirculation Aquaculture Tank Production Systems, Management of Recirculation Systems. SRAC Publication #452. 12 p.

Malison, J.A. 2003. A White Paper on the Status and Needs of Yellow Perch Aquaculture in the North Central Region. Prepared for North Central Regional Aquaculture Center.

Malison, J.A. 2006. Chair. Yellow Perch. Annual Progress Report. NCRAC. 2004-5. p. 63-76.

Malison, J.A. 2006. 2006. Historical Perspective of Yellow Perch Aquaculture. Mid-West Perch Forum. July 14, 2006. Stevens Point, WI.

Malison, J.A. and J.A.Held. Farm-based Production Parameters and Breakeven Costs for Yellow Perch Growout in Ponds in Southern Wisconsin. Unpublished – North Central Regional Aquaculture.

Malison, J.A. 1999 (updated 2003). A White Paper on the Status and Needs of Yellow Perch Aquaculture in the North Central Region. Special Publication of the North Central Regional Aquaculture Center, East Lansing, MI. 15 pp.

Morris, J.E. and C.C. Mischke. 1999. Plankton Management for Fish Culture Ponds. Technical Bulletin Series #114. Iowa State University Agricultural Experiment Station.

Morris, J.E. 2007. 2007. The History, Theory and Science of Pond Fertilization. Pond Fertilization Workshop – Managing the Bloom. Wausau, WI. March 9, 2007.

Pollock, C. 2005. Researchers Hope to Reel in High-performance Perch. In Alumni Alert. AG Answers, An Ohio State Extension and Purdue Extension Partnership. 2005.

Potter, J.T. 2002. Evaluation of Growout Culture Techniques for Yellow Perch, *Perca flavescens*, Utilizing a Tank/Pond Water Recirculating System. Final Report. Fishery Resource Grant Program - 00-AM-03

Riepe, J.R. 1997a. Enterprise Budgets for Yellow Perch Production in Cages and Ponds in the North Central Region, 1994/95. Technical Bulletin Series #111. NCRAC, Publications Office, Iowa State University, Ames.

Riepe, J.R. 1997b. Costs for Pond Production of Yellow Perch in the North Central Region, 1994-1995. NCRAC Fact Sheet Series #111, NCRAC Publications Office, Iowa State University. Ames.

Summerfelt, R. 1996. Ed. Walleye Culture Manual. NCRAC Culture Series 101. 416 p.

Wallat, G. and L. Tiu. 1999. Production and Feed Training of Yellow Perch Fingerlings. Piketon Research & Extension Center Sheet AQ(1)-1999, The Ohio State University, Piketon, OH.

West, W. M. 2006. Tandem Recirculation/Pond Production Numbers. Mid-West Perch Forum. July 14, 2006. Stevens Point, WI.

Personal Communication

Lynch, Bill. Mill Creek Perch Farms, LLC. Marysville, OH

Miller, Gene. Circling Waters Fish Farm. East Troy, WI